Supporting the Cyber Analytic Process using Visual History on Large Displays

Ankit Singh, Alex Endert, Christopher Andrews, Lauren Bradel, Robert Kincaid, Chris North

Virginia Tech

Agilent Laboratories

Overview

- Cyber Analytic Process
  - Benefits provide by large displays
- Visual History Design and Prototype
- Lessons Learned, Future Work

Large, High-Resolution Displays

- Personal Workspace
- Single Workstation
- Familiar OS, tools, ...
- Provides additional size, resolution to support analysts

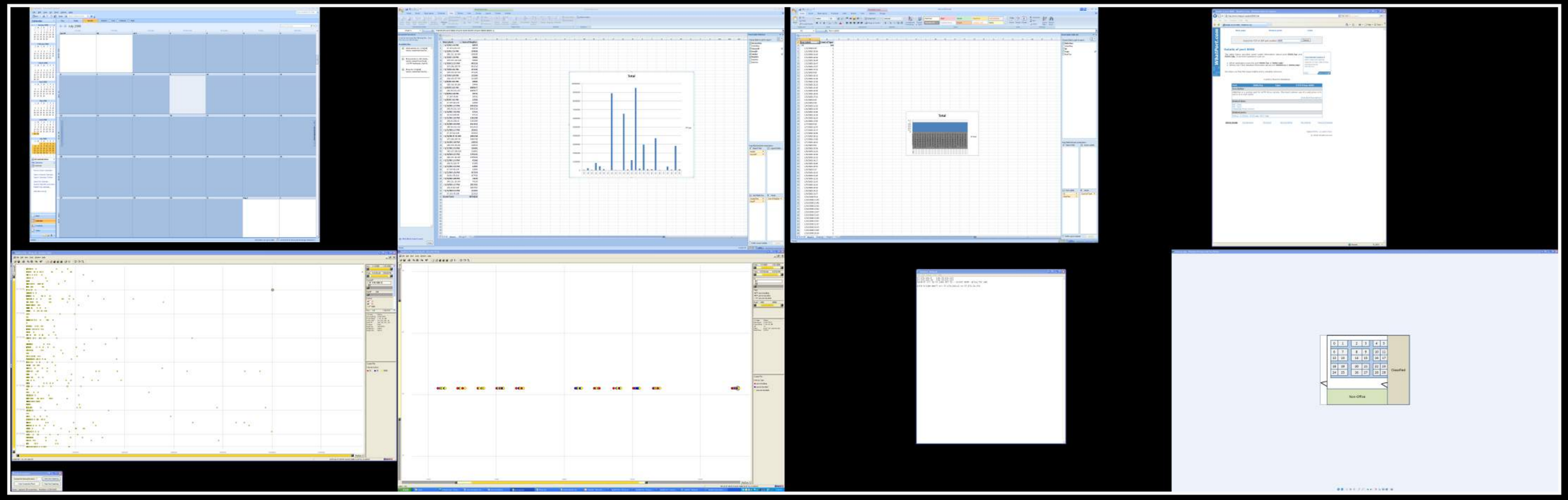
Cyber Analytic Process

- Interviewed 8 professional cyber analysts
- Observed 4 analysts analyze the 2009 VAST Challenge Dataset
  - Simulated Network Flows and Employee Building Access logs

from Fink, G., North, C., Endert, A. and Rose, S. Visualizing Cyber Security: Usable Workspaces. VizSec, 2009.

Cyber Analytic Process

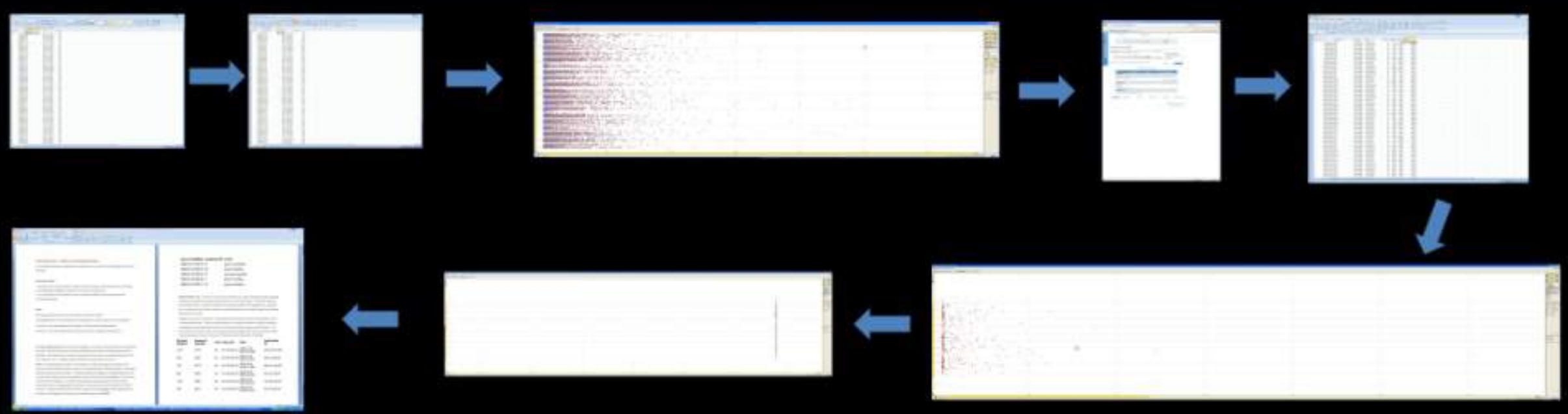
- Multiple data sources
- Multiple tools/windows
- Extensive Excel usage



from Fink, G., North, C., Endert, A. and Rose, S. Visualizing Cyber Security: Usable Workspaces. VizSec, 2009.

Cyber Analytic Process

- Versioning of files based on hypotheses
  - E.g., v1.1, v1.2, v2.1, ...
  - Reasons: save the data, save the view
- Difficult to re-create process to support findings at time of creating report



from Fink, G., North, C., Endert, A. and Rose, S. Visualizing Cyber Security: Usable Workspaces. VizSec, 2009.

Challenge

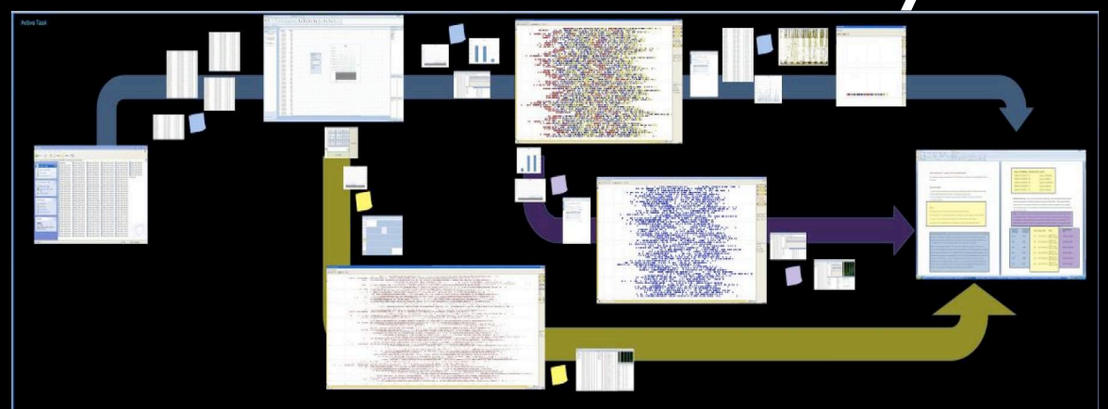
- How to design workspaces to support the complex cyber analytic process?

More Resolution and Size

De-Aggregation of Data

Case Management

Process History



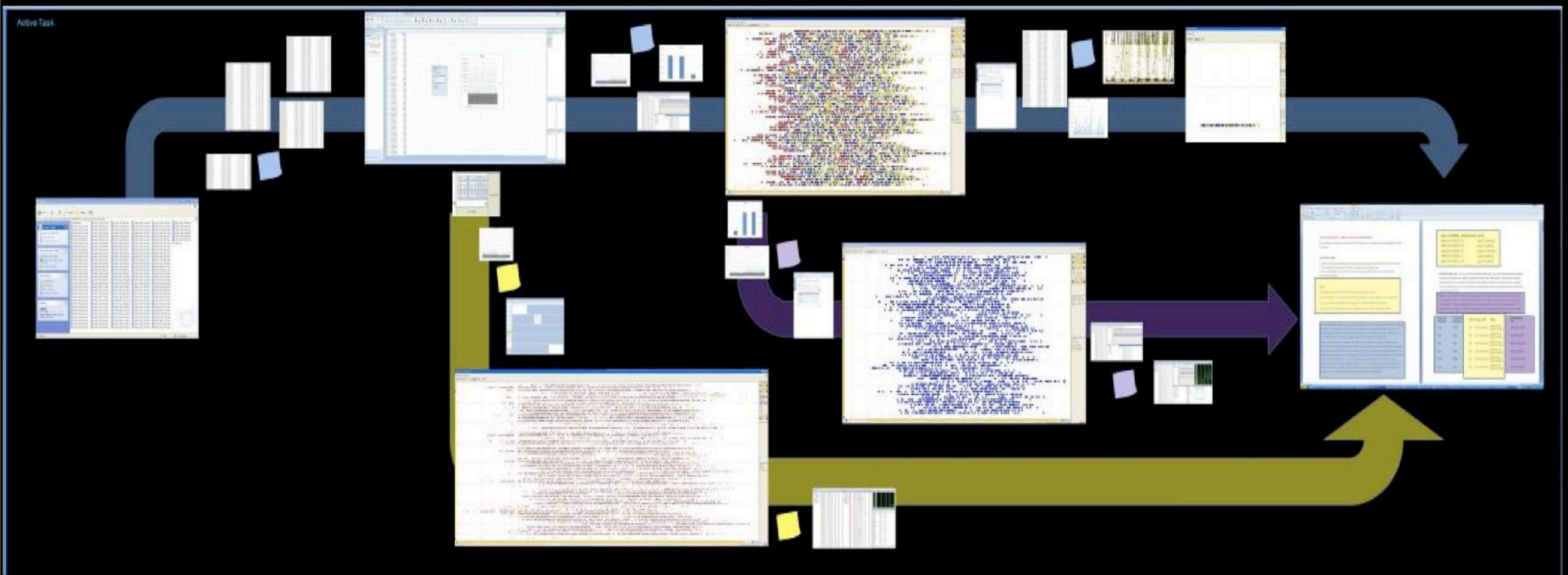
from Fink, G., North, C., Endert, A. and Rose, S. Visualizing Cyber Security: Usable Workspaces. VizSec, 2009.

Visual History: Design

Branching

Multiple Windows, File Versions

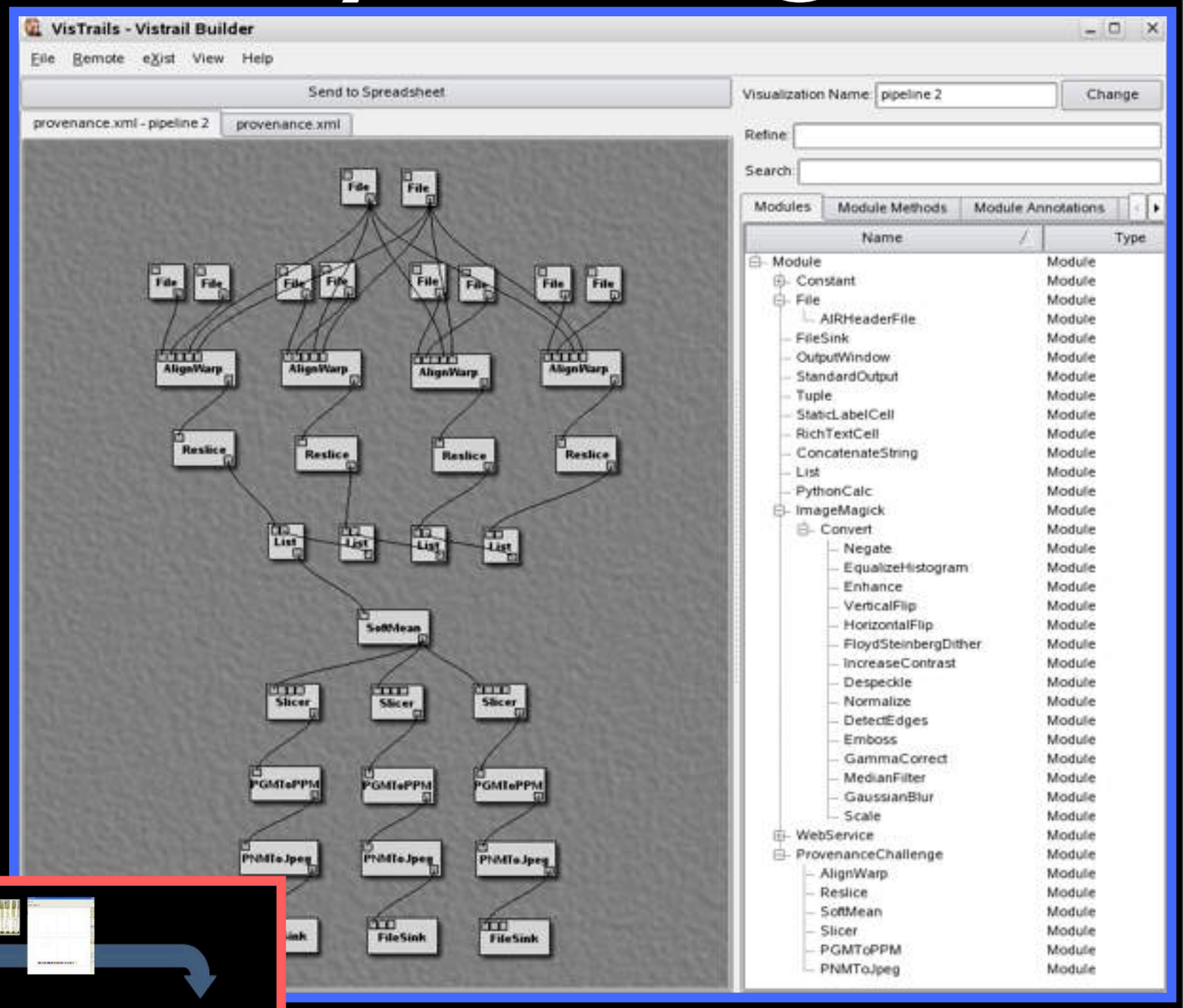
Process Traceability



from Fink, G., North, C., Endert, A. and Rose, S. Visualizing Cyber Security: Usable Workspaces. VizSec, 2009.

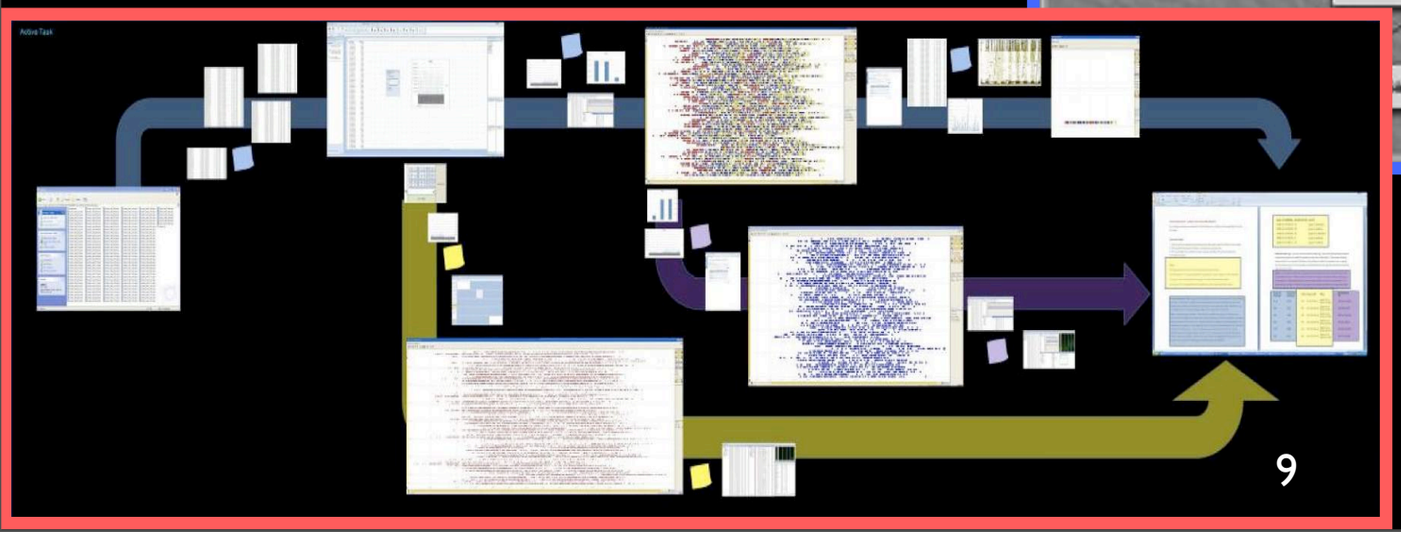
Visual History: Design

Visualization of workflow



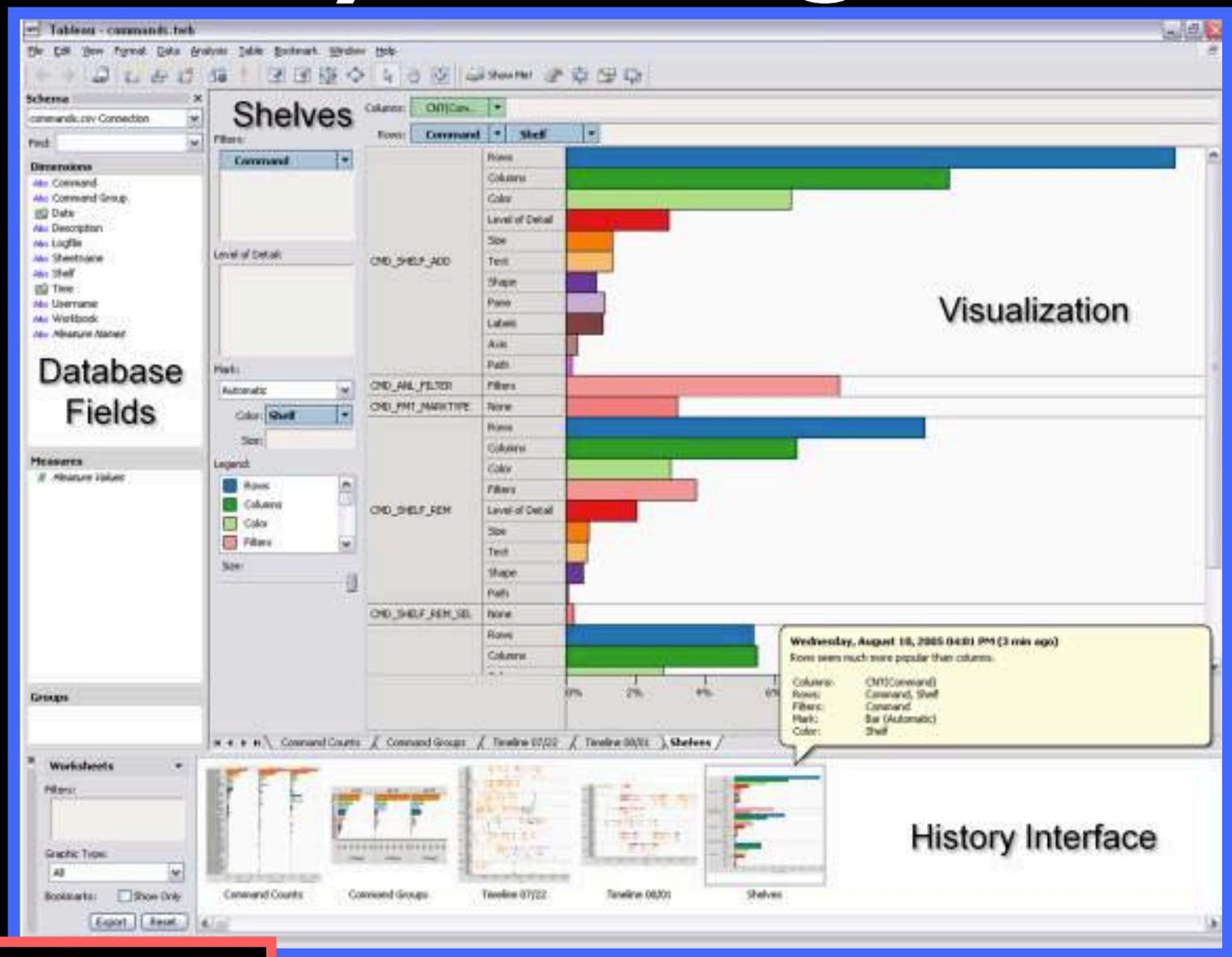
VisTrails, http://www.sci.utah.edu/~vgc/vistrails

Process integrated in workspace



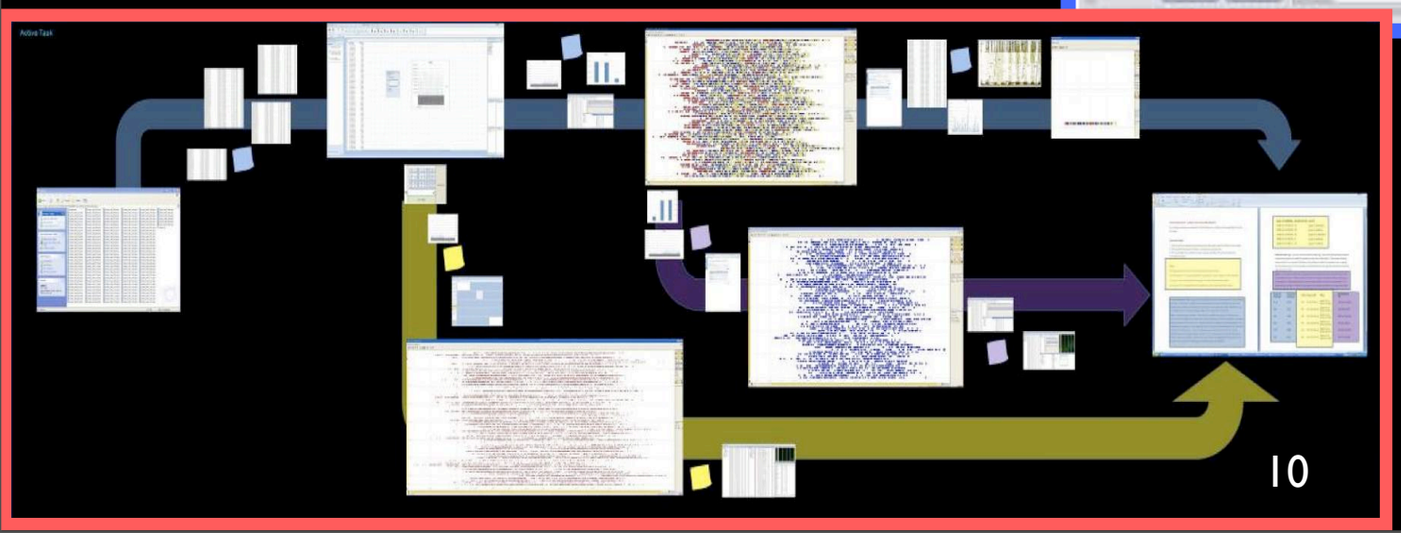
Visual History: Design

History stored away in thumbnails

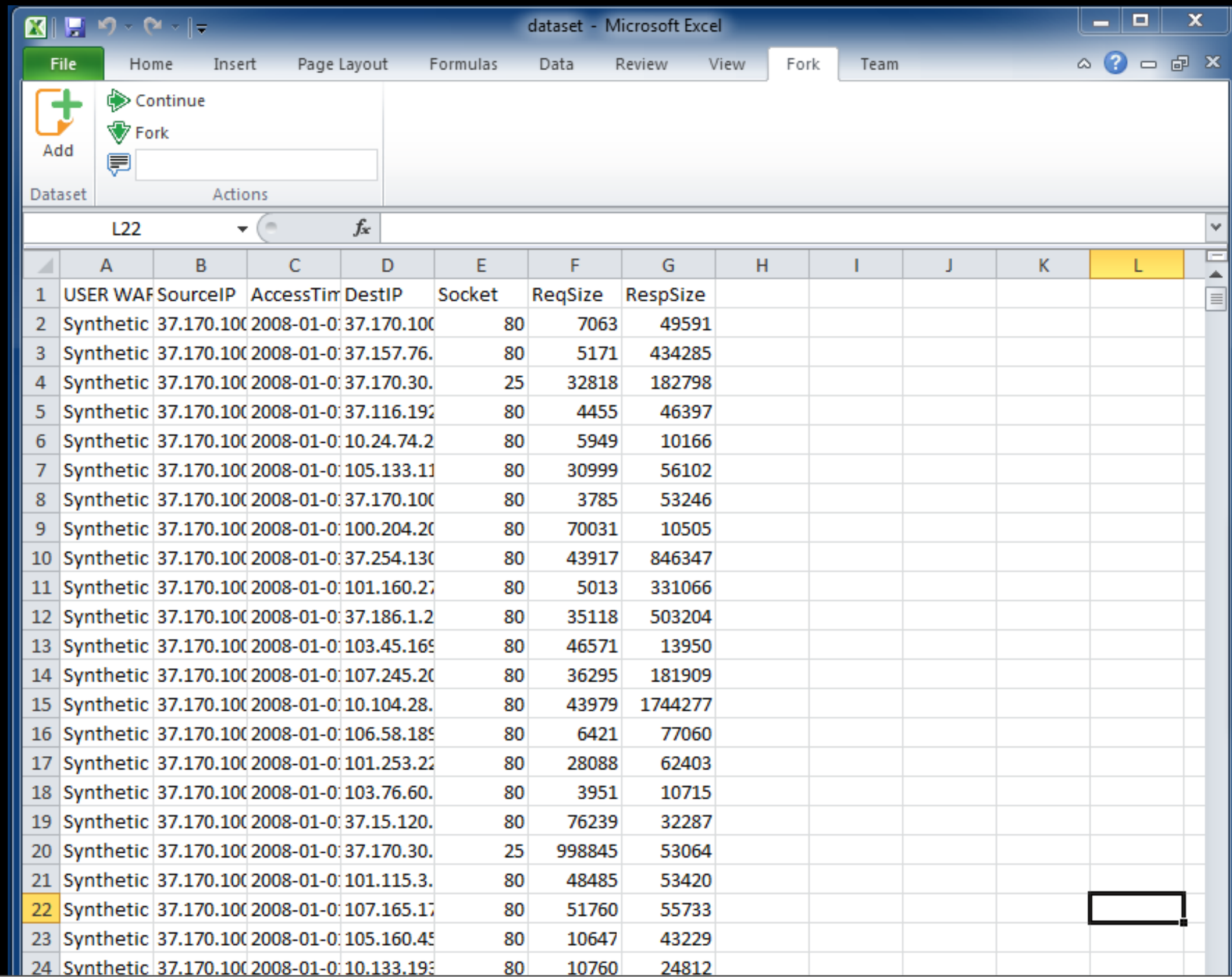


Tableau, image from http://hci.stanford.edu/jheer/files/jheer-thesis.pdf

Process integrated in workspace



Visual History: Implementation



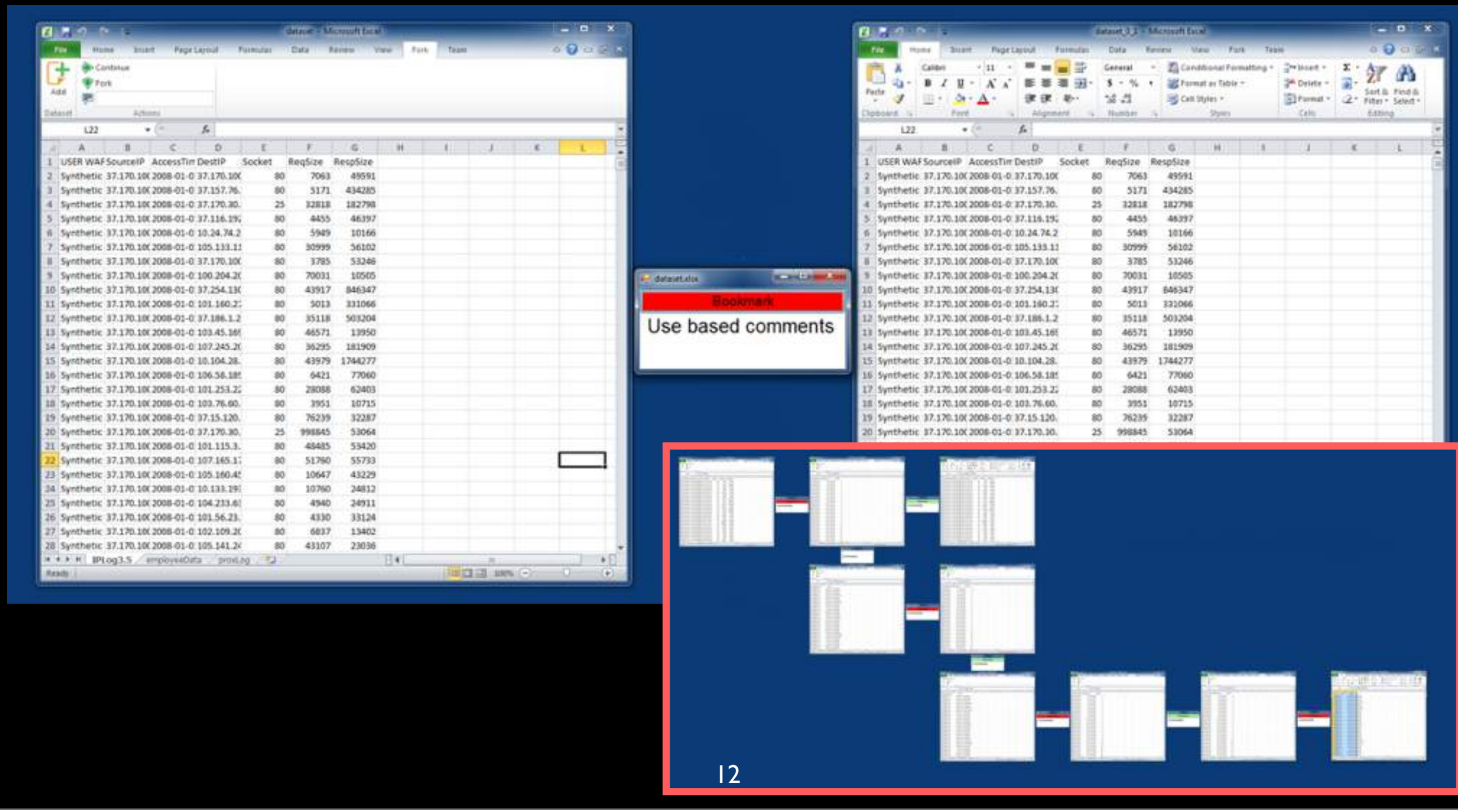
	A	B	C	D	E	F	G
1	USER WAF	SourceIP	AccessTim	DestIP	Socket	ReqSize	RespSize
2	Synthetic	37.170.10(	2008-01-0	37.170.10(	80	7063	49591
3	Synthetic	37.170.10(	2008-01-0	37.157.76.	80	5171	434285
4	Synthetic	37.170.10(	2008-01-0	37.170.30.	25	32818	182798
5	Synthetic	37.170.10(	2008-01-0	37.116.192	80	4455	46397
6	Synthetic	37.170.10(	2008-01-0	10.24.74.2	80	5949	10166
7	Synthetic	37.170.10(	2008-01-0	105.133.11	80	30999	56102
8	Synthetic	37.170.10(	2008-01-0	37.170.10(	80	3785	53246
9	Synthetic	37.170.10(	2008-01-0	100.204.20	80	70031	10505
10	Synthetic	37.170.10(	2008-01-0	37.254.130	80	43917	846347
11	Synthetic	37.170.10(	2008-01-0	101.160.27	80	5013	331066
12	Synthetic	37.170.10(	2008-01-0	37.186.1.2	80	35118	503204
13	Synthetic	37.170.10(	2008-01-0	103.45.169	80	46571	13950
14	Synthetic	37.170.10(	2008-01-0	107.245.20	80	36295	181909
15	Synthetic	37.170.10(	2008-01-0	10.104.28.	80	43979	1744277
16	Synthetic	37.170.10(	2008-01-0	106.58.189	80	6421	77060
17	Synthetic	37.170.10(	2008-01-0	101.253.22	80	28088	62403
18	Synthetic	37.170.10(	2008-01-0	103.76.60.	80	3951	10715
19	Synthetic	37.170.10(	2008-01-0	37.15.120.	80	76239	32287
20	Synthetic	37.170.10(	2008-01-0	37.170.30.	25	998845	53064
21	Synthetic	37.170.10(	2008-01-0	101.115.3.	80	48485	53420
22	Synthetic	37.170.10(	2008-01-0	107.165.17	80	51760	55733
23	Synthetic	37.170.10(	2008-01-0	105.160.45	80	10647	43229
24	Synthetic	37.170.10(	2008-01-0	10.133.193	80	10760	24812

Visual History: Implementation

Branching

Multiple Windows, File Versions

Process Traceability

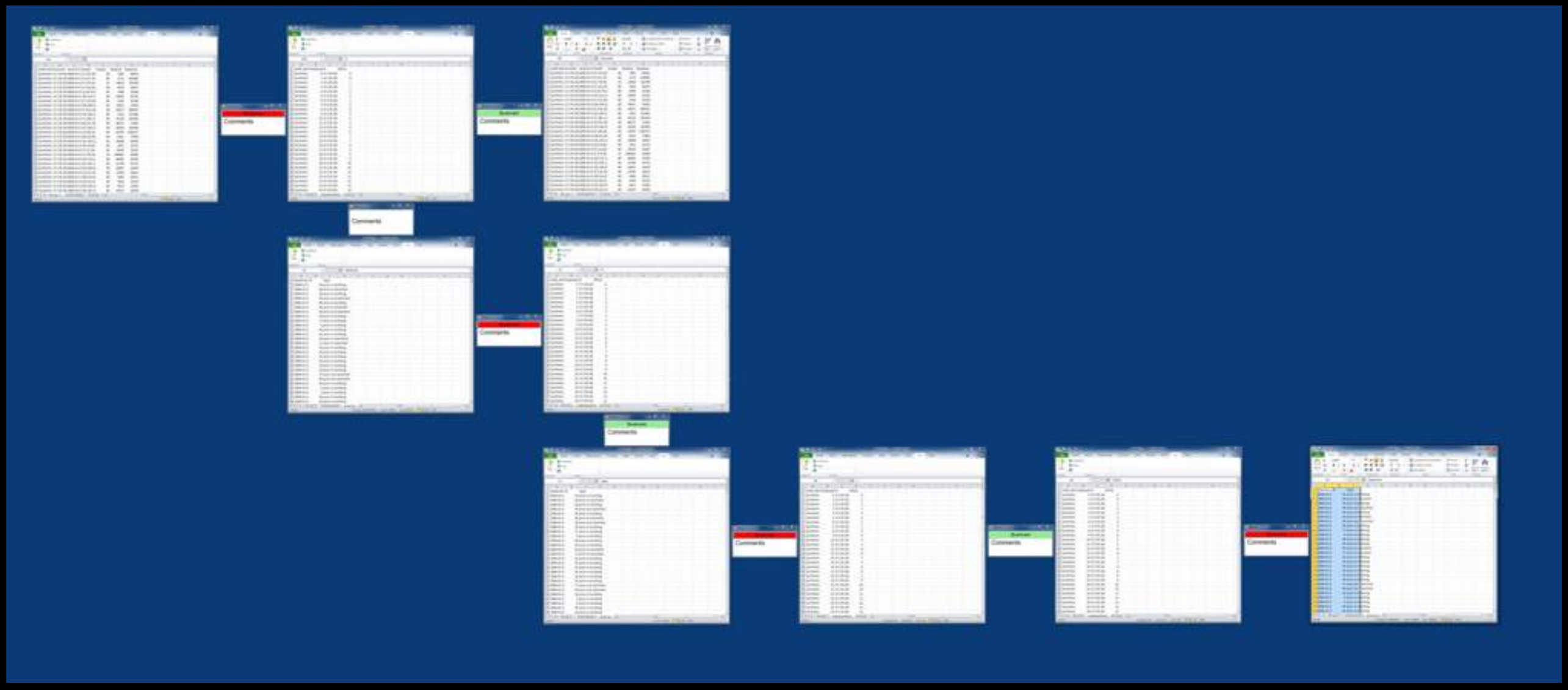


Visual History: Implementation

Branching

Multiple Windows, File Versions

Process Traceability



Visual History: Use Case

- 2009 VAST Challenge Dataset
  - Simulated Network Flows and Employee Building Access logs

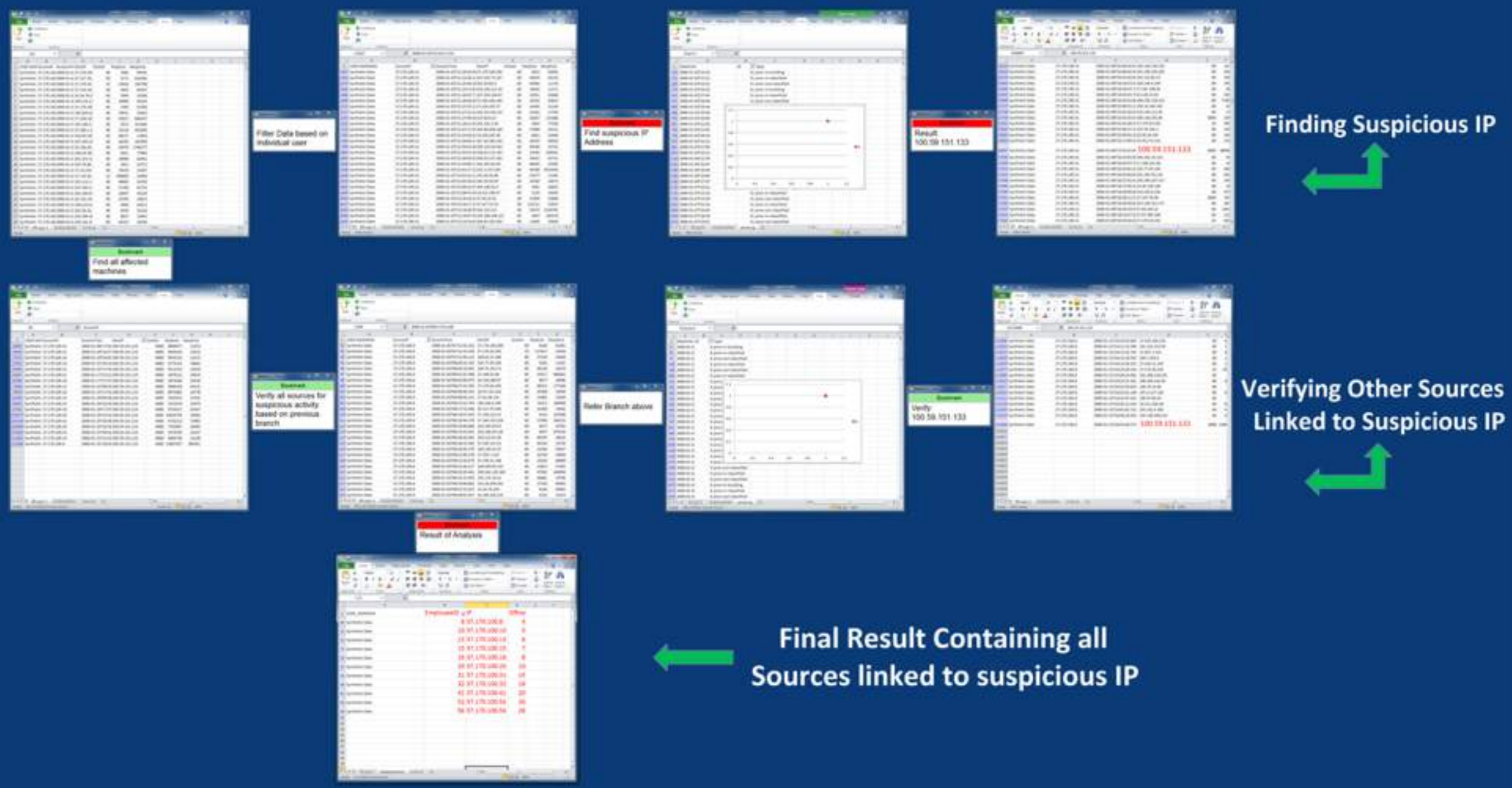
- Explore features in realistic scenario

Visual History: Implementation

Branching

Multiple Windows, File Versions

Process Traceability



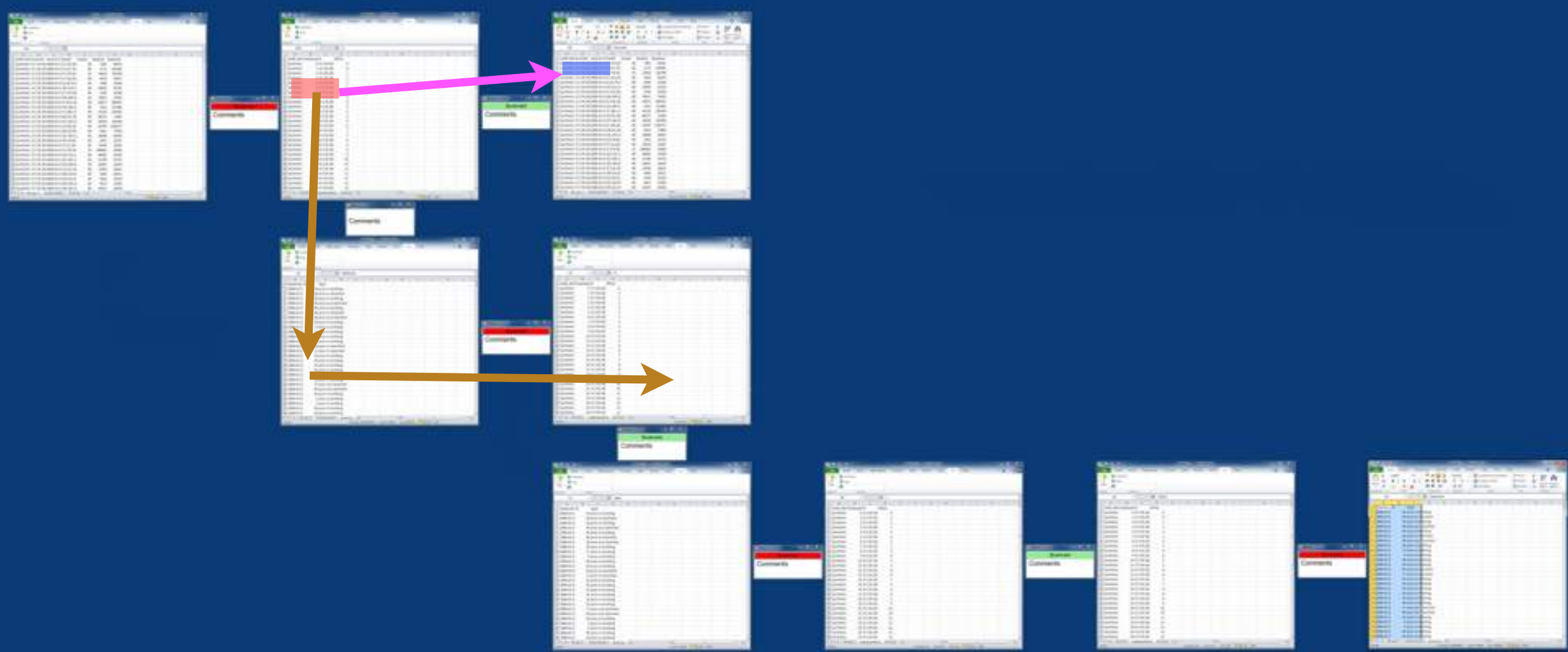
Use Case: Lessons Learned

- Propagating Changes vs. Branching new version
  - Brushing & Linking through Process
- Automatic vs. Manual Layout of History
  - When to fork, branch?
  - Running out of space?

Propagating vs. Forking

Visual History maintains process actively in the workspace.

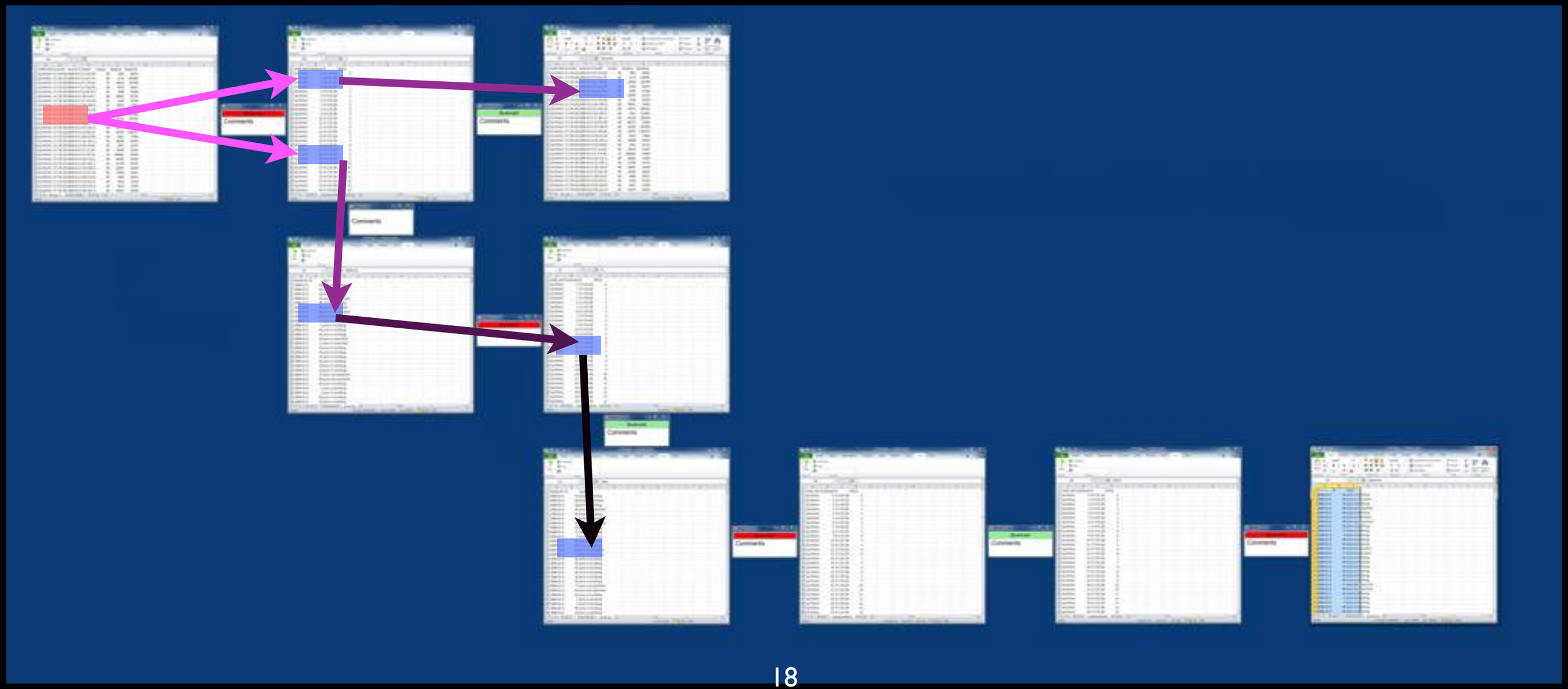
How to adjust workspace when previous states are changed?



Brushing & Linking through Process

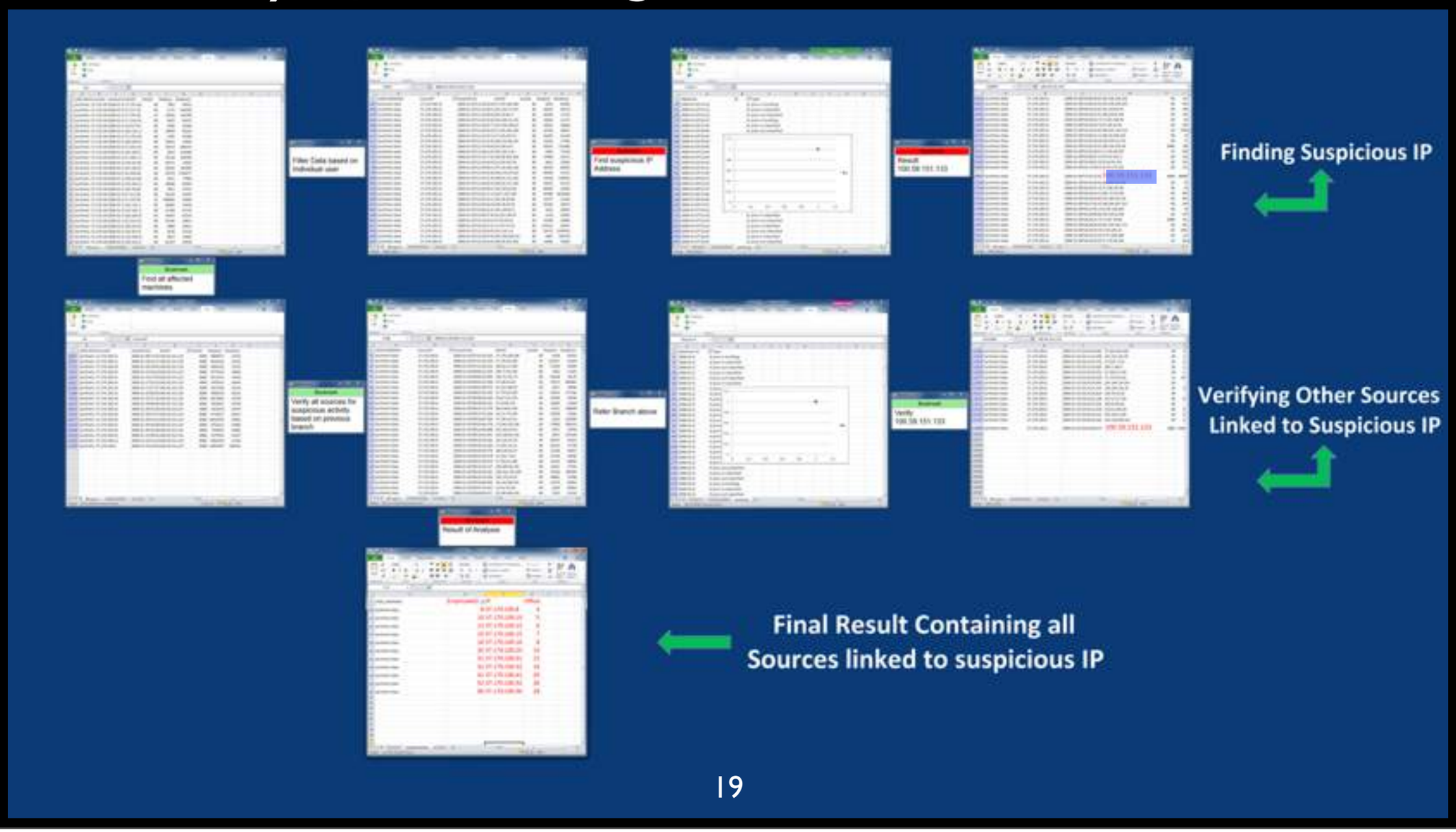
Visual History maintains process actively in the workspace.

How to highlight impacted downstream data?



Automatic vs. Manual Layout

- *Balancing automatic branching with user-defined positioning of windows*
- *How to handle display space limitations?*
- *Scalability of branching*



Future Work

- Evaluate design decisions from lessons learned
  - Implementation
- Formal user study evaluation
  - *How does keeping the history current impact the dynamic analytic process of the user?*

Conclusions

- Cyber Analytic Workspaces can support the *process* of the analyst
  - Combining algorithmic aids (e.g., sniffers, filters, alerts, ...) with human intuition
- With *Visual History*, we merge traditional "history" with "process"
- *Visual History* focuses on the importance of the user *process* as well as the *solution*

Conclusions

- Cyber Analytic Workspaces can support the *process* of the analyst
  - Combining algorithmic aids (e.g., sniffers, filters, alerts, ...) with human intuition
- With *Visual History*, we merge traditional "history" with "process"
- *Visual History* focuses on the importance of the user *process* as well as the *solution*

Thanks! Questions?